

FORM PTO-1390

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER

**TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371**

50395-098

U.S. APPLIC. NO. (if known, see 37 CFR 1.5)

09/807372

INTERNATIONAL APPLICATION NO.

INTERNATIONAL FILING DATE

PRIORITY DATE CLAIMED

PCT/JP99/04294

August 6, 1999

October 21, 1998

TITLE OF INVENTION

EQUIPMENT AND METHOD FOR MANUFACTURING A SOOT PREFORM

APPLICANT(S) FOR DO/EO/US

Kanta YAGI, Sumio HOSHINO, and Wataru KIKUCHI

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☐ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
 - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☐ has been transmitted by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
 - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☐ have been transmitted by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendment has NOT expired.
 - d. ☐ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A FIRST preliminary amendment.
☐ A SECOND or SUBSEQUENT preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information.

International Search Report prepared by JPO
International Preliminary Examination Report
Front page of published International application



20277

PATENT TRADEMARK OFFICE

U.S. APPLIC. NO. (if known, see 37 CFR 1.50) 09/807372		INTERNATIONAL APPLICATION NO. PCT/JP99/04294		ATTORNEY'S DOCKET NUMBER 50395-098									
				CALCULATIONS	PTO USE ONLY								
17. <input checked="" type="checkbox"/> The following fees are submitted: Basic National Fee (37 CFR 1.492(a)(1)-(5)): Search Report has been prepared by the EPO or JPO \$860.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) \$690.00 No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) \$710.00 Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$1,000.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) \$100.00 <div style="text-align: right;">ENTER APPROPRIATE BASIC FEE AMOUNT =</div>				\$ 860.00									
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input checked="" type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$ 130.00									
Claims	Number Filed	Number Extra	Rate										
Total Claims	7 -20 =	0	x \$18.00	\$									
Independent Claims	2 -3 =	0	x \$80.00	\$									
Multiple dependent claim(s) (if applicable)			+ \$270.00	\$									
TOTAL OF ABOVE CALCULATIONS =				\$ 990.00									
Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).				\$									
SUBTOTAL =				\$ 990.00									
Processing fee of \$130.00 for furnishing the English translation later than the <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				\$									
TOTAL NATIONAL FEE =				\$ 990.00									
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property.				\$									
TOTAL FEES ENCLOSED =				\$ 990.00									
				Amount to be refunded	\$								
				charged	\$								
a. <input type="checkbox"/> A check in the amount of \$ _____ to cover the above fees is enclosed. b. <input checked="" type="checkbox"/> Please charge my Deposit Account No. <u>500417</u> in the amount of \$ <u>990.00</u> to cover the above fees. A duplicate copy of this sheet is enclosed. c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. <u>500417</u> . A duplicate copy of this sheet is enclosed. NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.													
SEND ALL CORRESPONDENCE TO: McDERMOTT, WILL & EMERY 600 13 th Street, N.W. Washington, DC 20005-3096 (202) 756-8000 Facsimile (202) 756-8087													
<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border-bottom: 1px solid black;">SIGNATURE</td> <td style="width: 50%; border-bottom: 1px solid black;"></td> </tr> <tr> <td style="border-bottom: 1px solid black;">NAME</td> <td style="border-bottom: 1px solid black;">Arthur J. Steiner</td> </tr> <tr> <td style="border-bottom: 1px solid black;">REGISTRATION NUMBER</td> <td style="border-bottom: 1px solid black;">26,106</td> </tr> <tr> <td style="border-bottom: 1px solid black;">DATE</td> <td style="border-bottom: 1px solid black;">April 12, 2001</td> </tr> </table>						SIGNATURE		NAME	Arthur J. Steiner	REGISTRATION NUMBER	26,106	DATE	April 12, 2001
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NAME	Arthur J. Steiner												
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DATE	April 12, 2001												

Docket No.: 50395-098

PATENT**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Application of :

Kanta YAGI, et al. :

Serial No.: :

Group Art Unit:

Filed: April 12, 2001 :

Examiner:

For: EQUIPMENT AND METHOD FOR MANUFACTURING A SOOT PREFORM

PRELIMINARY AMENDMENTCommissioner for Patents
Washington, DC 20231

Sir:

Prior to examination of the above-referenced application, please amend the application as follows:

IN THE SPECIFICATION:

Please substitute the attached amended pages of specification for the corresponding pages of specification as filed. Also attached is a marked-up copy which contains handwritten changes.

REMARKS

Entry of this preliminary amendment is respectfully requested.

Respectfully submitted,

MCDERMOTT, WILL & EMERY



Arthur J. Steiner

Registration No. 26,106

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Washington, DC 20005-3096
(202) 756-8000 AIS:klm

Date: April 12, 2001

Facsimile: (202) 756-8087

09807372-071601

DESCRIPTION

Equipment and method for manufacturing a soot preform

Technical Field

5 The present invention relates to equipment and a manufacturing method for manufacturing a soot preform for an optical fiber, photomask or the like.

Background Art

10 For manufacturing a soot preform there are widely used methods, such as the VAD method and the OVD method. According to these methods, the gas of raw materials such as silicon tetrachloride and germanium tetrachloride is supplied to a burner together with a combustion gas and the like, and glass particulates that are formed by hydrolysis reaction therefrom are deposited on
15 the tip of or around a starting rod. The soot preform thus produced is dehydrated and sintered, resulting in a transparent vitrified preform. The transparent glass preform is melted by heating, and drawn to form an optical fiber.

Figure 4 is a sectional view illustrating the main part of equipment in
20 which a soot preform is produced. The numeral 1 shows a reaction vessel, 2 a burner, 2a flame, 3 an air inlet, 4 an exhaust port, 5 a starting rod, 6 a soot preform, and 7 the flow of an air current.

Gases, such as a raw material gas comprising silicon tetrachloride,

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consequently were unlikely to cause any special problem. Also, when the number of the voids having a diameter equal to or more than 1 mm that existed in the preforms was examined about 10 pieces of the above preforms that were in a state transparently vitrified by dehydration and sintering, the existence of 0.9 voids per preform was confirmed.

(Comparative example)

After manufacturing 10 pieces of preforms 6 in the same manner as in Example 1 except that the partition board 8 was not provided, the inside of the reaction vessel was examined. The quantity of the floating glass particulates that adhered to the inner wall surface in the space above the partition board 8 of the reaction vessel was considerably large. Also, when the number of the voids having a diameter equal to or more than 1 mm that existed in the preforms was examined about 10 pieces of the above preforms that were in a state transparently vitrified by dehydration and sintering, the existence of 5 voids per preform was confirmed. The number of voids is considerably larger as compared with Examples 1, 2, and 3. It is considered to be due to the numerous floating glass particulates that adhered to the soot preform.

The applicability in the industry

The soot preform manufacturing equipment of the present invention is constituted such that a partition board is provided in part of the space around a soot preform in a reaction vessel so that the space is separated into the upper and lower parts. An exhaust port is provided below the partition board in the

ABSTRACT

An object of the present invention is to reduce the adhesion of floating glass particulates to the surface of a soot preform during the manufacture of the soot preform, thereby reducing the voids generated in the transparent glass preform made from the soot preform, and to improve the quality of the optical fiber manufactured from the transparent glass preform. The equipment of the invention is equipped with a reaction vessel 1, a burner 2 provided within the reaction vessel 1 into which raw material gas and combustion gas are supplied so as to generate glass particulates by hydrolysis reaction, and a starting rod 5 onto which the glass particulates generated by the burner 2 are deposited. By drawing up the starting rod 5 while turning it around its axis, the glass particulates are deposited on the tip of or around the starting rod 5 to form a soot preform 6 in column-like shape. The equipment is provided with a partition board 8 that separates part of the space around the soot preform 6 in the reaction vessel 1 into upper and lower parts. An exhaust port 4 is provided below the partition board 8 in the inner wall of the reaction vessel 1, and the burner 2 is installed in the space below the partition board 8.

09807372-071601

DESCRIPTION

Equipment and method for manufacturing a soot preform
~~Porous glass base material production device and method~~

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Background Art

10 For manufacturing a soot preform there are widely used methods, such as the VAD method and the OVD method. According to these methods, the gas of raw materials such as silicon tetrachloride and germanium tetrachloride is supplied to a burner together with a combustion gas and the like, and glass particulates that are formed by hydrolysis reaction therefrom are deposited on
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Gases, such as a raw material gas comprising silicon tetrachloride,

consequently were unlikely to cause any special problem. Also, when the number of the voids having a diameter equal to or more than 1 mm that existed in the preforms was examined about 10 pieces of the above preforms that were in a state transparently vitrified by dehydration and sintering, the existence of 0.9 voids per preform was confirmed.

(Comparative example)

After manufacturing 10 pieces of preforms 6 in the same manner as in Example 1 except that the partition board ⁸ was not provided, the inside of the reaction vessel was examined. The quantity of the floating glass particulates that adhered to the inner wall surface in the space above the partition board 8 of the reaction vessel was considerably large. Also, when the number of the voids having a diameter equal to or more than 1 mm that existed in the preforms was examined about 10 pieces of the above preforms that were in a state transparently vitrified by dehydration and sintering, the existence of 5 voids per preform was confirmed. The number of voids is considerably larger as compared with Examples 1, 2, and 3. It is considered to be due to the numerous floating glass particulates that adhered to the soot preform.

The applicability in the industry

The soot preform manufacturing equipment of the present invention is constituted such that a partition board is provided in part of the space around a soot preform in a reaction vessel so that the space is separated into the upper and lower parts. An exhaust port is provided below the partition board in the

ABSTRACT

An object of the present invention is to reduce the adhesion of floating glass particulates to the surface of a soot preform during the manufacture of the soot preform, thereby reducing the voids generated in the transparent glass preform made from the soot preform, and to improve the quality of the optical fiber manufactured from the transparent glass preform. The equipment of the invention is equipped with a reaction vessel 1, a burner 2 provided within the reaction vessel 1 into which raw material gas and combustion gas are supplied so as to generate glass particulates by hydrolysis reaction, and a starting rod 5 onto which the glass particulates generated by the burner 2 are deposited. By drawing up the starting rod 5 while turning it around its axis, the glass particulates are deposited on the tip of or around the starting rod 5 to form a soot preform 6 in column-like shape. The equipment is provided with a partition board 8 that separates part of the space around the soot preform 6 in the reaction vessel 1 into upper and lower parts. An exhaust port 4 is provided below the partition board 8 in the inner wall of the reaction vessel 1, and the burner 2 is installed in the space below the partition board ⁴X.

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099052 as filed

JC03 Rec'd PCT/FPO

12 APR 2001

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DESCRIPTION

Porous glass base material production device and method

Technical Field

5 The present invention relates to equipment and a manufacturing method for manufacturing a soot preform for an optical fiber, photomask or the like.

Background Art

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15 the tip of or around a starting rod. The soot preform thus produced is dehydrated and sintered, resulting in a transparent vitrified preform. The transparent glass preform is melted by heating, and drawn to form an optical fiber.

20 Figure 4 is a sectional view illustrating the main part of equipment in which a soot preform is produced. The numeral 1 shows a reaction vessel, 2 a burner, 2a flame, 3 an air inlet, 4 an exhaust port, 5 a starting rod, 6 a soot preform, and 7 the flow of an air current.

Gases, such as a raw material gas comprising silicon tetrachloride,

09807372-071601

germanium tetrachloride, etc., a combustion gas such as hydrogen, oxygen, etc., and a separating gas such as argon which delays the mixing of hydrogen and oxygen, are supplied to the burner 2. Then, glass particulates made of quartz simple or quartz substance in which germanium oxidize, etc. is doped are produced in the flame 2a by hydrolysis reaction. Then, the glass particulates thus produced are deposited on the tip of the starting rod 5 or around the starting rod. The starting rod 5 is drawn up while turning around its axis. The deposit of the glass particulates grows in the radial and longitudinal directions of the starting rod, forming the soot preform 6 having an approximately columnar shape.

Part of the glass particulates generated in the flame 2a of the burner 2 are, without accumulating on the soot preform 6, allowed to flow upward by the flow of the high-temperature gas and float on the air current 7 in the reaction vessel. Then, the glass particulates thus floating, after the temperature declines by some degrees, adhere to the surface of the already formed soot preform, as well as the inner wall surface of the reaction vessel, in a different condition as compared with the bulk density of the preform.

When the glass particulates having adhered to the wall surface of the reaction vessel grow and fall off by of their own weight, etc, they will float in the reaction vessel and also adhere to the surface of the soot preform as described above.

The glass particulates having floated as described above and not deposited directly on the preform are in a state where the temperature has

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become lower as compared with the glass particulates that have been directly deposited on the preform. Accordingly, they differ in the physical properties such as the bulk density, and hence cause voids in the transparent glass preform. The voids tend to break an optical fiber when it is drawn from the transparent glass preform, or deteriorate the optical transmission characteristics of the optical fiber.

Disclosure of the Invention

The equipment and method for manufacturing a soot preform according to the present invention can restrain the floating of glass particulates in the reaction vessel that would occur if a soot preform is manufactured according to the conventional techniques. The novel equipment and method enables the manufacture of a soot preform from which a transparent glass preform of good quality, and hence a good quality optical fiber, can be produced.

The equipment for manufacturing a soot preform according to the present invention is, as in the case of conventional equipment, provided with a reaction vessel, a burner that generates glass particulates, and a starting rod on which the glass particulates are deposited.

The glass particulates are generated by hydrolysis reaction in the flame formed by burning the combustion gas that is supplied together with raw material gas to the burner provided in the reaction vessel. As in the case of conventional equipment, a soot preform is manufactured in an approximately columnar shape by depositing glass particulates to grow on the tip of the

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starting rod or around the starting rod while turning the starting rod around its axis and drawing it upward. The equipment according to the present invention is characterized in that a partition board is provided in part of the space around the soot preform in the reaction vessel such that the space is separated into upper and lower parts, and an exhaust port is provided below the partition board in the side wall of the reaction vessel and the burner is positioned in the space below the partition board. By such arrangement, the floating of the glass particulates in the reaction vessel can be limited to the lower part and hence the adhesion of the floating glass particulates to the soot preform can be reduced. As a result, the number of voids formed in the preform can also be reduced when the soot preform is vitrified to transparent glass.

Brief Description of the Drawing

Figure 1 (A) is a sectional view illustrating an embodiment of the main part of the soot preform manufacturing equipment according to the present invention, and Figure 1 (B) is a perspective view showing an embodiment of the partition board used in the manufacturing equipment according to the present invention.

Figure 2 is a sectional view illustrating an embodiment of the main part of the soot preform manufacturing equipment according to the present invention.

Figure 3 is a sectional view illustrating the flow of gas from an air inlet in the soot preform manufacturing equipment according to the present

09807372-071601

invention.

Figure 4 is a sectional view illustrating the flow of gas from an air inlet in conventional soot preform manufacturing equipment.

5 Best Mode for Carrying out the Invention

Figure 1 (A) is a sectional view illustrating an embodiment of the main part of the soot preform manufacturing equipment according to the present invention, and the identical signs indicate the same representation in Figure 4.

Figure 1 (B) is a perspective view showing an embodiment of the partition board used in the soot preform manufacturing equipment according to the present invention. In Figure 1, the numeral 8 indicates a partition board, 8a a preform passage hole, 9 sling members such as a wire or rod, 10a and 10b hooks.

The partition board 8 is placed maintaining its board surface horizontal as shown in Figure 1 (A) such that part of the space between the inner wall surface of the reaction vessel 1 and the soot preform 6 is separated into upper and lower parts. The burner 2 is placed in the space below the partition board 8, and the exhaust port 4 is provided below the partition board, in the wall of the reaction vessel. The air inlet 3 is provided in the wall of the reaction vessel, opposite to the exhaust port 4. It is provided according to need and there are cases where no air inlet is provided.

The interval L between the partition board 8 and the exhaust port 4 is preferably 100 - 400 mm. When the interval L is smaller than 100 mm and the

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partition board and the exhaust port are too close to each other, the partition board 8 may be heated with the flame of the burner 2 to be deformed. When the interval L exceeds 400 mm, the glass particulates that do not deposit directly onto the soot preform cannot be led to the exhaust port smoothly, and they will float in the reaction vessel. Therefore, more preferably, the interval L is 200 - 300 mm.

The outer diameter of the soot preform 6 sometimes differs slightly from one preform to another or in terms of the longitudinal direction of the same preform, even if it is the same in design. When the preform passage hole 8a provided in the partition board 8 is narrow, the soot preform 6 may touch the partition board 8 when the soot preform is drawn up through the preform passage hole. Therefore, the gap between the partition board 8 and the preform 6 should be equal to or more than 10 mm. If the gap is sufficiently large for manufacturing several sizes of soot preforms, it is advantageous in that a partition board need not be replaced every time when soot preforms having a different outer diameter in design is manufactured. However, when the gap exceeds 80 mm, the flow of the air current through the gap into the upper part of the space that is above the partition board in the reaction vessel increases, which results in allowing the glass particulates to float within the reaction vessel. Thus, more preferably, the gap is 10 - 50 mm.

There are cases where manufacturing conditions such as the number of burners provided, the angle of a burner, the kind and the flow rate of gas to be supplied, etc. are changed according to the kind of the preforms to be

manufactured. In such cases, it is desirable to make the partition board 8 movable up and down so that the partition board 8 may not be deformed by the heat of the flame from the burner 2. It is therefore preferable to make the partition board 8 movable up and down complying with such need.

5 The partition board 8 shown in Figure 1 (A) is suspended from the top of reaction vessel 1 with sling members 9 such as wires and rods. Therefore, the position of the partition board can be altered only by changing the length of the sling members 9. The partition board 8 shown in Figure 1 (A) is supported using the sling members 9 and the hooks 10a and 10b that are fixed on the
10 partition board 8 and the ceiling of the reaction vessel 1, respectively. It is possible, however, to support the partition board with support stands 11 fixed on the wall of the reaction vessel 1 as shown in Figure 2. It is sufficient that the partition board can be moved by altering the length of the sling members because usually the position of the partition board need not be moved while
15 manufacturing a soot preform. In the case in which the position of the partition board needs to be moved during manufacturing, there may be provided a mechanism for the partition board to moved up and down be continuously and stopped at a desired position.

20 The partition board 8 must be made of a material that has thermal resistance and acid resistance and does not adversely affect the quality of the soot preform for the optical fiber. Nickel, quartz, and silicone carbide have excellent characteristics suitable for the above material. The partition board 8 may use a simple substance out of the above materials, but a complex

substance including the above materials can also be used. The sling members 9 and the hooks 10a and 10 b are also preferably made of the above materials, such as nickel.

As shown in Figure 3, if outside fresh air or clean air filtered through an air filter is introduced from the air inlet 3 into the lower space below the partition board 8 while glass particulates are generated within the flame 2a of the burner 2 and deposited on the soot preform 6, the floating glass particulates that do not deposit directly onto the preform 6 tend to flow to the exhaust port 4 with the gas flow 7. As a result, the floating glass particulates that enter through the gap between the preform 6 and the partition board 8 into the space above the partition board 8 decrease. This results in the decrease of the adhesion of the floating glass particulates to the inner wall surface of the reaction vessel 1 and the surface of the preform 6.

[Example 1]

In a reaction vessel 1 made of nickel and having the form shown in Figure 1 (A) with the dimensions of 400 mm \times 400mm in a horizontal cross section, and 1800 mm in height, wherein a partition board 8 made of nickel is provided at a position of 200 mm above from the upper end of an exhaust port 4, soot preforms 6 of 150 mm in outer diameter and 600 mm in length were manufactured. The gap between the partition board 8 and the preform 6 was about 30 mm. After manufacturing 10 pieces of preforms 6, the inside of the vessel 1 was visually inspected. There was little adhesion of the floating glass particulates on the inner wall surface of the space above the partition board in

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the reaction vessel. Also, when the number of voids having a diameter equal to or more than 1 mm which existed in the preforms was examined about 10 pieces of the preforms mentioned above in a state transparently vitrified by dehydration and sintering, the existence of 0.5 voids per preform was confirmed.

[Example 2]

After manufacturing 10 pieces of preforms 6 in the same manner as in Example 1 except that the gap between the partition board 8 and the preform 6 was about 50 mm, the inside of the reaction vessel was examined. The quantity of the floating glass particulates that adhered to the inner wall surface in the space above the partition board 8 of the reaction vessel was very small, and was not likely to cause any special problem. Also, when the number of the voids having a diameter equal to or more than 1 mm that existed in the preforms was examined about the above 10 pieces of the preforms that were in a state transparently vitrified by dehydration and sintering, the existence of 1.0 voids per preform was confirmed.

[Example 3]

After manufacturing 10 pieces of preforms 6 in the same manner as in Example 1 except that the gap between the partition board 8 and the preform 6 was about 30 mm and the interval between the partition board 8 and the exhaust port 4 was 300mm, the inside of the reaction vessel was examined. The floating glass particulates were not recognized as having adhered to the inner wall surface in the space above the partition board 8 of the reaction vessel, and

consequently were unlikely to cause any special problem. Also, when the number of the voids having a diameter equal to or more than 1 mm that existed in the preforms was examined about 10 pieces of the above preforms that were in a state transparently vitrified by dehydration and sintering, the existence of 0.9 voids per preform was confirmed.

(Comparative example)

After manufacturing 10 pieces of preforms 6 in the same manner as in Example 1 except that the partition board 6 was not provided, the inside of the reaction vessel was examined. The quantity of the floating glass particulates that adhered to the inner wall surface in the space above the partition board 8 of the reaction vessel was considerably large. Also, when the number of the voids having a diameter equal to or more than 1 mm that existed in the preforms was examined about 10 pieces of the above preforms that were in a state transparently vitrified by dehydration and sintering, the existence of 5 voids per preform was confirmed. The number of voids is considerably larger as compared with Examples 1, 2, and 3. It is considered to be due to the numerous floating glass particulates that adhered to the soot preform.

The applicability in the industry

The soot preform manufacturing equipment of the present invention is constituted such that a partition board is provided in part of the space around a soot preform in a reaction vessel so that the space is separated into the upper and lower parts. An exhaust port is provided below the partition board in the

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side wall of the reaction vessel and a burner is positioned in the space below the partition board.

In the equipment of the present invention, the floating of the glass particulates in the reaction vessel can be limited to the lower part and hence the adhesion of the floating glass particulates to the soot preform can be reduced. Since the adhesion of the floating glass particulates to the soot preform can be reduced, the number of voids formed in a transparent glass preform manufactured from the soot preform can be reduced. Also, as a result of the decrease in the quantity of the voids in the transparent glass preform, not only can breakage of an optical fiber be reduced when the transparent glass preform is drawn into the optical fiber by heating and melting, but also excellent optical transmission characteristics of the optical fiber can be attained.

Also deformation of the partition board due to the heat of the burner flame can be prevented, if the partition board is movable up and down. This allows it to be adjusted to the most suitable position to correspond with the change of the manufacturing conditions, such as the number and angle of the burners, and the quantity and kinds of gases, such as a raw material gas, supplied to the burners. If the partition board is made of nickel, quartz, and/or silicone carbide, it does not adversely affect the quality of a soot preform for an optical fiber, and it is possible to achieve a stable manufacturing condition.

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CLAIMS

1. Equipment for manufacturing a soot preform, comprising a reaction vessel, a burner that generates glass particulates, and a starting rod on which the glass particulates are deposited, said equipment being further equipped
5 with a partition board which is provided in part of the space around a soot preform in said reaction vessel such that the space is separated into an upper and lower part, an exhaust port is provided below said partition board in the side wall of said reaction vessel, and said burner is positioned in the space below said partition board.

10 2. Equipment for manufacturing a soot preform as defined in Claim 1, wherein the interval between said partition board and said exhaust port is 100 to 400 mm.

3. Equipment for manufacturing a soot preform as defined in Claim 1, wherein a hole for the passage of said soot preform is provided in said partition
15 board such that the gap between said partition board and said soot preform is 10 to 80 mm.

4. Equipment for manufacturing a soot preform as defined in Claim 1, wherein said partition board is suspended by sling members from an upper position of said reaction vessel such that said partition board is movable up and
20 down.

5. Equipment for manufacturing a soot preform as defined in Claim 1, wherein said partition board is made of one or more materials selected from the group consisting of nickel, quartz, and silicone carbide.

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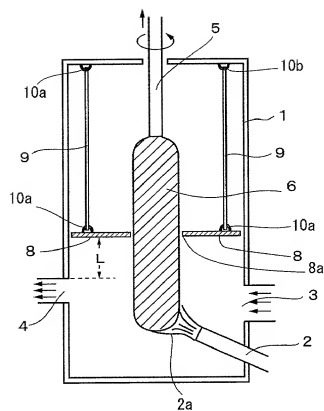
6. Equipment for manufacturing a soot preform as defined in Claim 1, wherein an air inlet is provided at a position opposite to said exhaust port below said partition board, in the wall of said reaction vessel.

7. A method for manufacturing a soot preform by depositing glass
5 particulates, which are generated by hydrolysis reaction caused by combustion gas and raw material gas supplied to a burner provided in a reaction vessel, on the tip of or around a starting rod while turning said starting rod around its axis and drawing it up, said reaction vessel having a partition board provided
10 in part of the space between said soot preform and the inner wall of said reaction vessel at a position above an exhaust port and said burner which are provided in the wall of said reaction vessel such that the space is separated into the upper and lower parts.

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Fig. 1

(A)



(B)

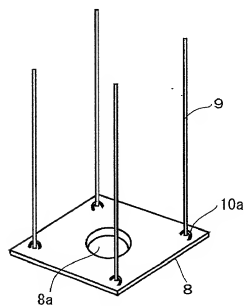


Fig. 2

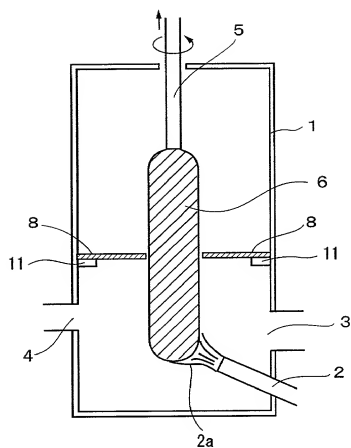


Fig. 3

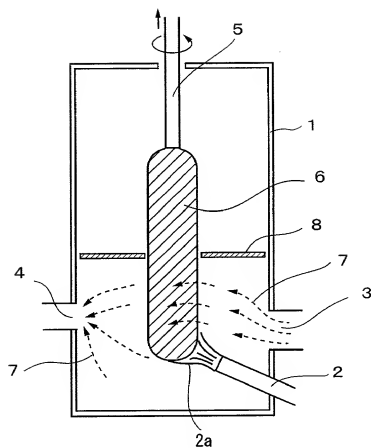
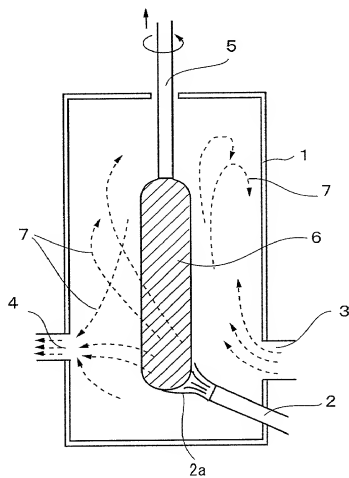


Fig. 4



BINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY

 Attorney's Docket Number
 50395-098

#4.

es Reference to PCT International Application(s)

ow named inventor, I hereby declare that:

idence, post office address and citizenship are as stated below next to my name,

 ve I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the
 t matter which is claimed and for which a patent is sought on the invention entitled:

PMENT AND METHOD FOR MANUFACTURING A SOOT PREFORM

ecification of which:

is attached hereto.

was filed as United States application Serial No. 09/807,371

on April 12, 2001

and was amended on (if applicable).

was filed as PCT international application Number PCT/JP99/04294

on August 6, 1999

and was amended under PCT Article 19 on (if applicable).

 by state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment
 ed to above.

nowledge the duty to disclose information which is known to me to be material to patentability in accordance with Title 37, Code of Federal Regulations,

 by claim foreign priority benefits under Title 35, United States Code, §119(a)-(d) or Section 365(b) of any foreign and/or international application(s) for
 it or inventor's certificate or Section 365(a) of any PCT international application(s) designating at least one country other than the United States of
 ca listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s)
 (nating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the
 cation(s) of which priority is claimed:

IR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

COUNTRY (If PCT, indicate "PCT")	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 USC 119
IN	10/299513	21/10/1998	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

by claim the benefit under 35 USC §119(e) of any United States provisional application(s) listed below.

IR PROVISIONAL APPLICATION(S):

Application Number	Filing Date

I hereby claim the benefit under Title 35, U.

States Code, §120 of any United States application(s), or §365(c) of any PCT international application(s)

designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which occurred between the filing date of the prior application(s) at the national or PCT international filing date of this application.

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:

U.S. APPLICATIONS			STATUS (Check One)		
U.S. Application Number	U.S. Filing Date		Patented	Pending	Abandoned
PCT APPLICATIONS DESIGNATING THE U.S.					
PCT Application No.	PCT Filing Date	U.S. Serial Numbers Assigned (if any)			
PCT/JP99/04294	August 6, 1999				

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I hereby declare that all statement made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Signature of Inventor 201:

Signature of Inventor 202:

Signature of Inventor 203:

Date May, 25, 2001 Date May, 25, 2001 Date May, 22, 2001